

ART. VIII.—Notes on *Mastotermes darwiniensis* Froggatt
(Isoptera).

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Quite apart from the importance of *Mastotermes* as a factor in the economic development of certain parts of tropical Australia, this insect, in some respects the most primitive of all *Isoptera*, is of considerable academic interest on account of its relationship with the Orthopteroid Families *Blattidae* and *Mantidae*. The closeness of the relationship between *Mastotermes* and the *Blattidae* has been demonstrated recently as a result of the morphological studies of Crampton, who records in his latest paper (1923) the presence beneath the 7th sternite of the alate female of the former "a fully formed ovipositor composed of three pairs of well-developed valves—a thing never before found in any winged termite, so far as I am aware!" On a subsequent page of the same paper he states:—"In the *Isoptera*, *Blattids* and *Mantids* . . . the 7th sternite becomes elongated posteriorly to form a subgenital valve. . . . which partly conceals the ovipositor in *Mantids*, and completely hides the ovipositor in most *Blattids* and such termites as have an ovipositor. I do not know what function this structure has in *Mastotermes*, but in the roach . . . the inner walls of the hypogynum form the lining of an oothecal cavity in which the ootheca is carried about by the mother roach for a period. . . . It is probable that in *Blattids*, *Mantids* and *Isoptera* the hypogynum forms a genital cavity functioning in the process of mating." From the above it appears to me that Crampton must have been on the verge of discovering the remarkable mode of oviposition recorded by me a few weeks later in a paper read at the second Pan-Pacific Congress, wherein it was stated that:—"The nearest allies of *Mastotermes* are found in the Family *Calotermitidae* . . . but there are morphological characters in the former which differentiate them sharply from the *Calotermes*. . . . The highly developed wings and the possession of a true worker caste in *Mastotermes* are among the important distinguishing features . . . but they are of less importance than the remarkable development of the reproductive organs of the female and the mode of oviposition. The external genitalia are unlike those of any other species of termite inasmuch that the comparatively simple structure of the *Calotermes* is represented in *Mastotermes* by a more complex arrangement closely resembling the *Blattidae* in general and some of the northern

species in particular. In all other known species of termites . . . the eggs are extruded separately . . . but in *Mastotermes* they are extruded in masses, each comprising from 16 to 24 eggs . . . cemented together laterally to form two parallel rows. These hitherto unrecorded facts demonstrate a relationship between the *Blattidae* and the *Termitidae* far closer than has been previously suggested."

The foregoing was written in ignorance of Crampton's work, and was not accompanied by detailed descriptions and figures of either the insect or its egg-mass; nor is it my intention now to discuss the former in view of the above writer's published work and his special qualification for a study of the ample material now in his possession, but it seems advisable to give some further details and a figure of the latter, as well as some field observations, in view of the fact that such specimens are likely to remain rare objects in entomological collections.

As a general account of the habits of *Mastotermes*, and its importance as a pest, appeared in a recent publication (Hill, 1921) it is unnecessary to refer to them again here; it may be mentioned, however, that the range of distribution in North Australia is somewhat greater than has been recorded previously, i.e., to the 23rd degree S. lat. on the East Coast, to the 20th degree in Central Australia, and to the 22nd degree on the West Coast.

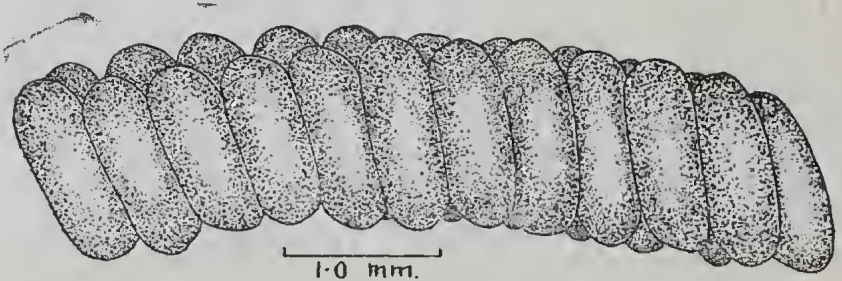


FIGURE I.

Egg-mass of *Mastotermes darwiniensis* Froggatt.

The Egg-mass.—The egg-mass (Text-fig. 1) is tawny in colour, and generally contains 22 or 24 eggs (rarely as few as 16), laid side by side in two parallel rows. The eggs rest at an angle of from 65 to 80 degrees from the perpendicular, and are so placed that when viewed from the side the upper and lower surfaces of the mass are convex and concave respectively. The individual eggs are firmly cemented together by a light brown gelatinous secretion, which is sufficiently copious to completely fill the interstices between the eggs and, in some places, to extend to the exposed outer surfaces. Under a low power (Oc. 4, obj. 2/3) the shell appears to be smooth and glossy. The following are details of the two masses now available for examination:—

	A.	B.
Extreme length of mass	5.13	4.44
„ width „	0.68	0.68
„ depth „	1.11	1.00
Number of eggs in mass	22	24
Eggs, long	1.08 to 1.25	
„ wide	0.39 to 0.40	

The Nest and Its Occupants.—The nest from which these eggs were taken (30 miles S.E. of Darwin, Northern Territory, 21/11/13) was situated at the base of a fence-post ten inches in diameter, which had been cut from a sound growing tree and erected four years earlier on a well-drained gravelly ridge. Within two years *Mastotermes* had so far destroyed the entire line of posts that the wires were removed for use elsewhere, and at the end of the fourth year most of the posts had completely disappeared, only a row of holes and fragments of timber indicating the former line of fencing. The post in which the nest was situated was reduced to a mere shell above ground level, and was practically non-existent below, the wood having been almost entirely removed and replaced by tier upon tier of large cells and galleries enclosed in a casing composed of a mixture of comminuted wood and earth. The colony, excepting a few soldiers and workers, was found below ground level, the upper portion of the post being almost filled with earth and alimentary rejectamenta. Many soldiers and workers were found in passages radiating from the nest at varying depths below the surface, and extending into the surrounding soil. These subterranean passages measured from 6 to 7 mm. in height by 10 to 12 mm. across, and, in the vicinity of the nest, were “floored” with a deposit of rejectamenta up to 2 mm. in depth. Four or five egg-masses were found near the bottom of the nest, but it is probable that many more were overlooked among the nest debris and thousands of struggling termites and ants. Individuals representing all stages of development, from recently hatched larvae to mature workers, soldiers and imagos, were abundant, but no “first-form” or “third-form” kings or queens were found, although both may have been present. In this, as in other cases, very careful examination was almost impossible owing to the attacks of thousands of ants (*Iridomyrmex sanguineus* Forel) upon both the termites and myself.

Masses of eggs similar to those previously described were found subsequently in this locality in January and June. On both occasions “third-form” neoteinic males and females were found, but there was no trace of “first-form” kings and queens, though they may have been present. Recently hatched larvae have been found throughout the year, indicating that egg-laying is not confined to any particular season.

Reproductive Castes.—“First-form” or “true” kings and queens, i.e., reproductive forms derived from de-alated imagos,

have not been found in this species. I attribute this fact firstly to the great difficulty one has experienced in finding the nests, and, having found them, in being able to investigate them carefully, secondly to the probability that both "royalties" are scarcely larger and less active than the de-alated imagos from which they have developed, and, thirdly, to the circumstance that all the nests I have seen were occupied at the time by many hundreds of fully developed alate, or accidentally de-alated, insects, among which the reproductive individuals would be difficult to find.

"Second-form" kings and queens (i.e., neoteinics derived from nymphs of the "second-form") also are unknown. It seems probable that they do not exist in this species.

"Third-form" kings and queens (i.e., neoteinics derived from nymphs of the "third-form" or stage, preceding the first appearance of wing-buds do occur, however, and have been found twice in nests and on several occasions with foraging parties of soldiers and workers. A small colony, comprising about one thousand more or less mature workers and soldiers, accompanied by six male and two female "third-form" neoteinics, was found in a small dead stump near Darwin, N.T. (20/4/14). There was no regular nest and no egg-masses, young larvae, nymphs or "first-form" queen. In the same locality (21/11/13) a well-established but small colony, comprising workers, soldiers, many larvae, several egg-masses, and about five hundred alate males and females, was found to contain also five of these neoteinics, none of which appeared to be ovigerous. Similar individuals were found at Townsville, N.Q.—one in association with a great number of workers and soldiers in the stem of a Pandanus plant, another with workers and soldiers under a heavily infested log, and a third in the base of a much-damaged fence-post.

Description of "Third-form" King and Queen.—Colour uniform dark amber; gross appearance "ergatoid," but easily distinguished from the worker caste by its darker colour, hairy head, thorax and abdomen and narrow head; male with styli and short 7th abdominal sternite; female without styli, and long 7th sternite; antennae 25-jointed; pronotum as in worker; eyes small, 0.285×0.228 mm in diameter, rudimentary, not pigmented; ocelli wanting; head, thorax and legs covered with long, moderately stout reddish hairs, the latter nearly, if not quite, as numerous in soldier and worker, but in both the sterile castes they are very short, fine and pale in colour. Measurements: total length 9.00 to 9.50 mm.; head wide 2.50 (2.67 in worker); pronotum long 1.42, wide 2.56. Ciliates (Trichonympha) are present in the hind gut, as in the imago.

Nymphae.—Nymphs of the second and first-form, both of which are to be found together in the nests at the end of August, are alike in having a pronotum resembling that of the imago, styli in both sexes and females with a long 7th sternite, as in the neoteinic queen of the "third form." They are distinguished as follows:—

	Second Form.	First Form.
Total length	12.00 mm.	16.00 mm.
Eyes, diameter	0.513×0.570	0.680×0.85
Head, wide	2.50	3.00
Pronotum, long	1.71	2.05
" wide	3.13	3.87
Mesonotum, to apex of wind-bud, long	3.13	6.00
Abdomen, wide	4.00	5.00
Antennae	28-jointed	31-jointed

The above details refer to specimens taken on the same date (21/11/13), and from the same colony. "Second-form" nymphs greatly outnumbered those of the "first-form," indicating that moulting had commenced recently.

It is believed that the number of antennal joints in *Isoptera* increases independently of ecdyses; whether this is so or not I am unable to say, but the rate of increase shown above appears to be remarkable.

Colonizing Flight.—Observations made in Darwin, N.T., and district, during the years 1912-1917, show that the earliest emergence recorded there on 23rd November and the latest on 17th December; whilst the earliest record of fully developed alate imagos in the nest was 21st November. There are no definite records to show the duration of the period intervening between the final moult and the complete hardening of the wings, nor, indeed, of the number of moults through which *Mastotermes* pass in the course of their development. The earliest appearance of wing-buds follows a moult which takes place in January, and the resulting "nymph of the second-form" moults again about the end of August, becoming a "nymph of the first-form," in which stage it remains until the final moult takes place—about the middle of October, it is thought. From thence the young imago develops from the soft-bodied, creamy-white insect with fragile, wrinkled white wings into the dark brown, more or less rigid-winged "flying-ant" so familiar to residents of tropical Australia. In Townsville, where records were kept by the writer for four years, the earliest observed flight occurred on 24th December and the latest on 23rd January. In 1921 there were flights on 24th and 26th December in a limited area affected by local rain storms, but the main flights commenced on 4th January following (the date of the first heavy general rain of the season) and continued at intervals to the 23rd January. In Hughenden, a dry inland district of N. Queensland, flights occurred as late as 4th February in 1922. In Townsville the transition from the third to the second-form nymph has been observed as late as 1st July. The emergence of the flight is determined by climatic conditions; hence their earlier and more regular appearance in the Darwin district, where the rainy season commences earlier and the fall is more regular than in Townsville.

It might be mentioned here that the alate imago, like the soldiers and workers, have no perceptible odour, such as exists in *Rhinotermes*, some *Eutermes*, and, to a marked degree, in some *Blattidae*.

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